SPRING INSTRUCTION MANUAL

V 0.1

Thank you for using the SPRING, a fast optical interference detecting device.

Before you using SPRING, please carefully read this instruction manual to fully understand the operations and the attentions.

Any other problem on instruction or purchasing please contact us through ustc.igem.2015@gmail.com

SAFETY NOTICE

⚠ WARNING

SPRING utilizes genetically engineered bacteria response to specific substrates, please be careful when operating with biological materials and seriously handling the device.

Please following those indispensable notices below when you use SPRING,

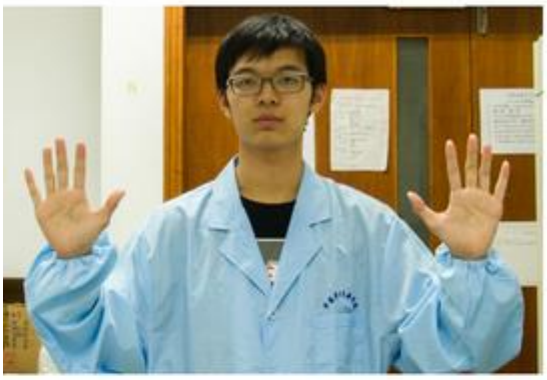
- Operate your instrument according to the instruction manual.
- **DO NOT** touch any optical element inside SPRING unless you can fix it.
- **DO NOT** use excessive under-test sample in order to avoid liquid spreads to the electric circuits.
- **DO NOT** watch straight to the laser.

We defined four level protection methods for safety, please do follow our suggestion when operating or repairing SPRING,

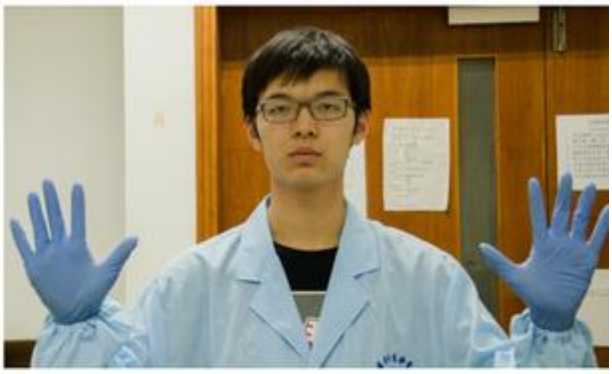
- Level A: Fundamental protective measure when producing NDM and conducting experiment. You may wear lab coat. When conducting experiments and assemble NDM, level A should be satisfied always.
- Level B: Personnel should not only wear lab coat, but wear nitrile gloves or latex gloves, which are necessary when touching bacteria solution. This procedure is the first step for detection.
- Level C: Level C is the standard protocol for personnels when drilling. In addition to level

A, you should wear goggles. Goggles would protect your eyes when you are drilling plexiglass. And please do remember ROLL UP YOUR SLEEVES to prevent possible hurts and DO NOT WEAR GLOVES because it is not convenient when drilling.

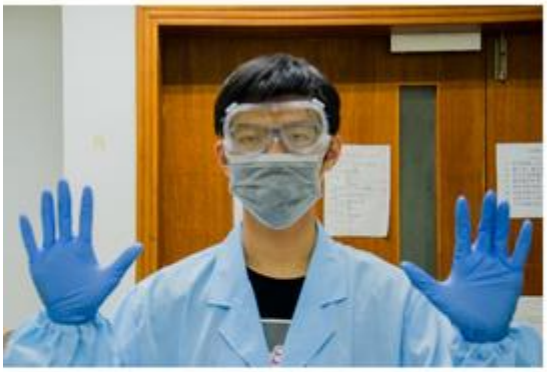
- Level D: This is the highest complicated protective measure for spraing painting procedure. One should wear lab coats, along with goggles, masks and gloves to toally protect oneself considering extreme pungent odor volatilizing when painting.



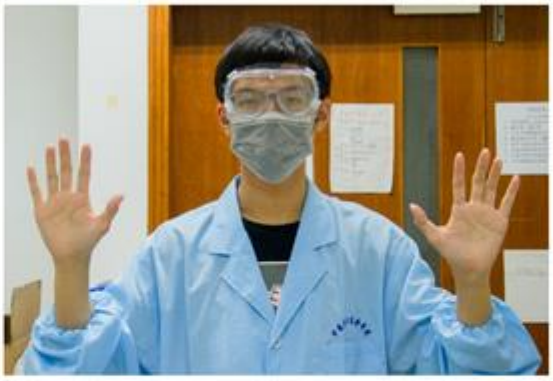
A



B



D



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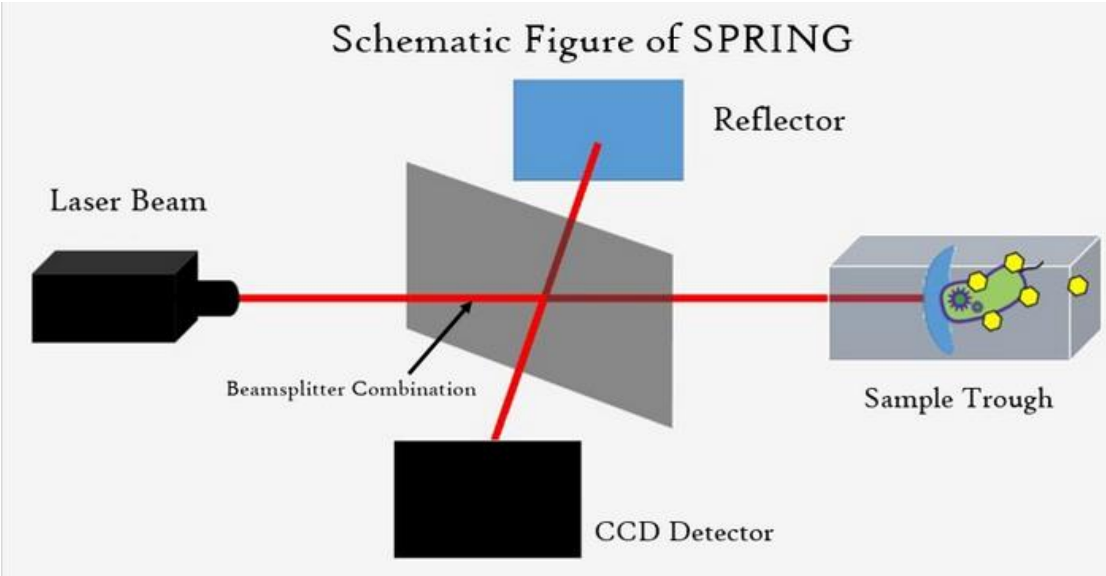
Specifications

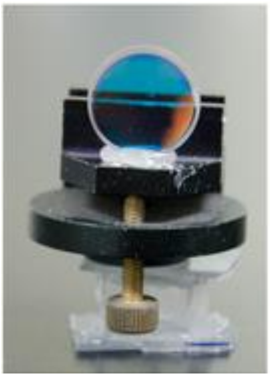
Name		SPRING
Laser	Working voltage	5.0V
	Wave length	650nm
Reflector	Total reflector	x1
	50% reflector	x1
	80% reflector	x1
	10% reflector	x1
Sample Trough	Size	40mmx40mmx40mm
	Material	PMMA
	Sample volume	58-62ml
CCD	Area	
	Distinguishability	
Laser Beam Expander	Times	8
Film	Material	Low pressure PE
	Coating solution	20ug/ml PLL
	Coating time	>4h
	Coating temperature	4℃
Platform		Raspberry Pi
Screen		
Battery	Output Voltage	12.0V
Transformer	Input/Output Voltage	12.0V/5.0V(tunable)

Structure

Optical part



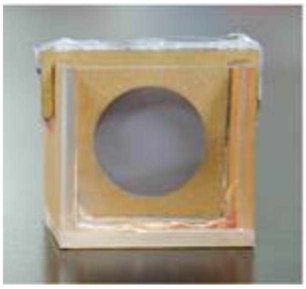
Elements includes:



Reflector

Beamsplitter Combination

Webcam

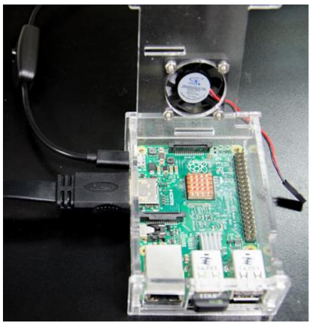


Sample Trough with Film

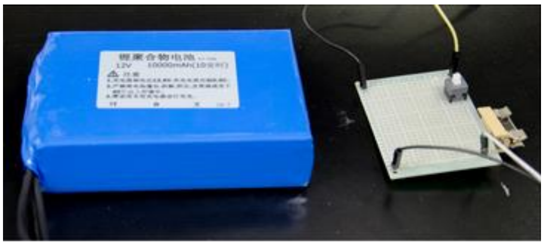
Laser Beam with Expander

Electric part

Transformer

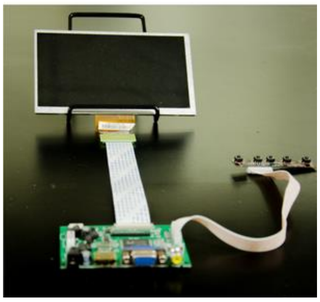


Raspberry Pi



Lithium Battery

Display Module



Operation

1. **Film storage**

Store the film in 4°C environment, avoid strong ultraviolet ray and high pressure or high temperature.

NOTICE: If you didn't purchase our matched film, you can make your own film. More details on film making please refer to our wiki tutorials part or contact us.

2. Open device

Open the Raspberry Pi, enter command window, input "luvcview" and press enter to enter CCD camera interface. Drag the window into a suitable position to get the instruct bottom below the interface.

3. Sample solution

Add sample solution into container, make the volume of sample between 58 to 62 ml.

Caution: DO NOT add more than 64ml or less than 50ml liquid.

4. Bacteria Adhesion

- Take out a new film and check double side of the film. If the film is broken or polluted please change another one.
- Wear lab coat and lab gloves.
- Soak the film in bacteria solution for about 100 second.*
- Wash the film with wash solution twice immediately.
- Dry the clip rapidly.
- Put the clip into sample solution container at the recommended position.

5. Optical path adjustment

- Put the container on the base and spin the container 180̊.
- Push or pull container at the recommended position on slideway, observe the screen if there is a interference fringes.
- Wait for about 100 second from the film contact with bacteria to observation.**

NOTICE: If you can not observe interference at any position you can change the position of the clip. If you still can't observe the interference please contact us and send a crash reporter.

6. Take images

When you observe a interference image, click the bottom "take a picture". Take a serial pictures in a row (4-5 pictures in a flash).

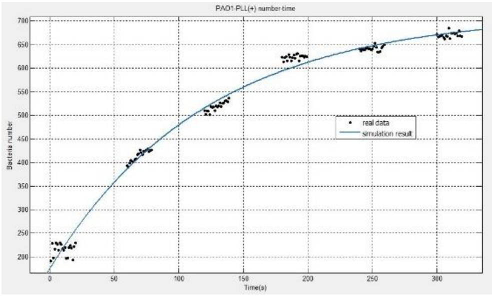
7. Image analysis

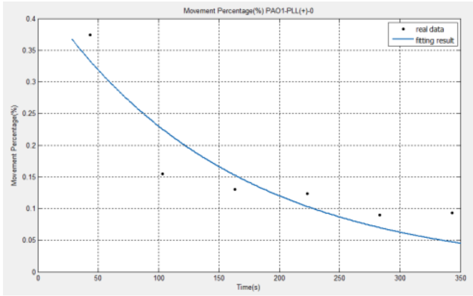
- Open the image analysis program.
- Loading the serial pictures you take just now.
- Choose two point in the processed image. Selectable point will shown in green when you move your mouse pointer on it.
- Enter the wave length (/nm) and radius (/m) of the film you choose.
- Click "analyse" bottom and see the result.

Explanation

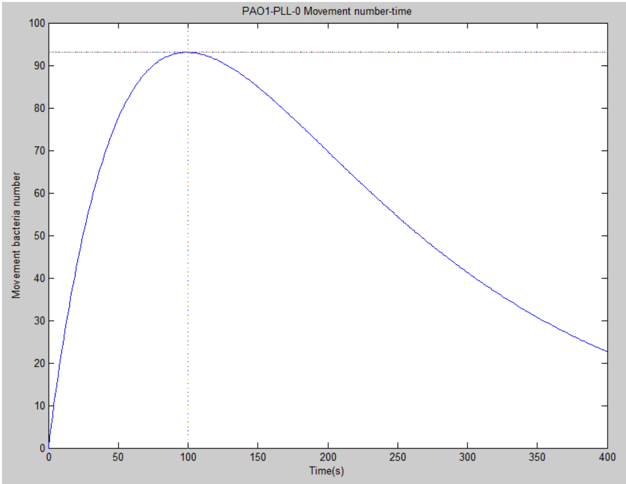
✧ **:** The film was under special treatment that have positive charge on the one side while have considerable reflectance on the other side. In general situation 100s adhesion operation can keep both bacteria number and activated number in a proper range. The properties of adhesion shown below.

Total number -- Time Curve: Movement percentage -- Time Curve:

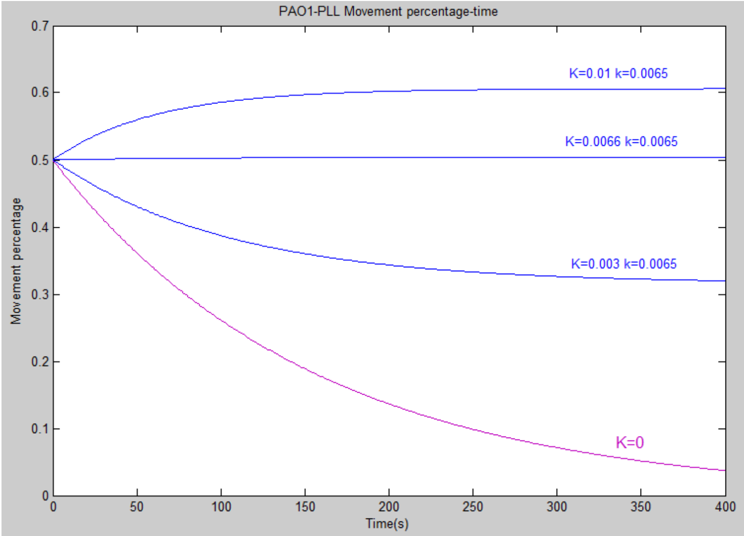




Movement number -- Time Curve:



✧ : After we administrate antibiotics, the bacteria will react in a very short time. When the action of bacteria step in steady stage can display a stable interference. And the best time to observe interference is the time that movement percentage reach the 95% of the maximum value or 105% of the minimum value. The test of reaction result shown below.



NOTICE : According to the safety rule of microorganism operation, the film must be carefully handle after use. And remember to shut down the device.